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THE PHILOSOPHY OF ARISTOTLE.

Translated from the German of G. W. F. HEGEL.

III.—THE PHILOSOPHY OF NATURE.

Of the special sciences which Aristotle has treated, the PHYSICS contains an entire series of works on physical subjects which form a tolerably perfect arrangement of the material constituting the entire compass of Nature-Philosophy. We will give the general plan. His first work is his *Physical Science, or Concerning Principles* (*Φυσικὴ ἀρχαὶς ἢ περὶ ἀρχῶν*), in eight books. He treats therein of the comprehension of the idea of Nature in general—of *Motion*, and of *Space* and *Time* as it belongs to it. The first manifestation of the Absolute Substance is MOTION, and its moments are space and time; this idea of its manifestation is the universal, which realizes itself first in the material world, passing over into the principle of individualization. Aristotle's Physics include what is called by the physicists of the present day the Metaphysics of Nature; for our science of Physics includes a treatment only of the visible, and of the delicate and excellent instruments they have made—not what has been *thought* about the matter. Directly after this first work of Aristotle follow his books concerning the heavens, which treat of the nature of body in general and of the first real bodies—the earth and the heavenly bodies; and besides this it treats of the general abstract relation of bodies to each other through mechanical heaviness and lightness, which we call *attraction*; finally, of the abstract real bodies, or the *elements*. Then follow the books upon origination and decay, the physical process of CHANGE (previously the *ideal* process of motion was considered). Besides the physical elements, those moments also enter here which are posited in the process as such: heat, cold, &c. The former elements are the real, permanent side; the latter determinations are the moments of beginning or ceasing which occur only in motion. After this follows the subject of Meteorology; it exhibits the general physical process in its most real forms. Here are treated particular determinations: rain, saltiness of the sea,

clouds, dew, hail, snow, frost, wind, rainbow, boiling, cooking and baking, colors, &c. Upon some subjects, e. g. colors, Aristotle wrote separate treatises. Nothing is forgotten; still the exposition is very empirical. The book on the World, with which he concludes, is held to be spurious: a special treatise addressed to Alexander, in part contains the general principles of things such as are already found in another place, and hence it does not belong in this cyclus.—From this Aristotle passes over to the treatment of Organic Nature; and among his works are found not only a Natural History, but also a Physiology and Anatomy. To Anatomy belong his works concerning Locomotion, and concerning the Parts of Animals. Upon Physiology, he speaks in the writings concerning the Birth of Animals, and concerning the Common Movement of Animals; then he treats of certain distinctions—of youth and old age, of sleeping and waking; he speaks of breathing, of dreaming, of the length of life, &c.,—all of which he treats partly empirically, partly speculatively. Finally, there follows the History of Animals; not, however, merely as Natural History in the ordinary sense, but rather as a treatise of animals in general—a sort of physiological-anatomical anatomy, if the expression may be allowed. Besides this, a botanical treatise upon plants (*περί φυτῶν*) is ascribed to him. Thus we see here Natural Philosophy in the entire completeness of its external content.

As regards this plan in general, there is nothing said to show that it is or is not the necessary order in which natural philosophy or physics must be treated. For a long time physics has retained this form and tendency, inherited from Aristotle, to deduce the parts of science from the idea of the whole; so that even the non-speculative method has retained this connection as external arrangement. This order is to be preferred to the arrangement in vogue in our physical textbooks: they present a quite irrational succession of objects heaped together at random, and indeed this is more in accordance with that mode of consideration of nature which seizes upon the sensuous phenomena of nature quite without comprehension and reason. At an earlier period physics contained still something of metaphysics; but as experience

showed that they were not able to come to an agreement in that field, the physicists have resolved to hold aloof from it as much as possible, and to hold fast to what they call "experience." For they suppose that they obtain in the field of experience the pure truth uncontaminated with thought, fresh from the hand of Nature, in their grasp and before their eyes. Although they cannot do without the IDEA, yet they have a way of letting pass as current coin, through a kind of silent assent, certain ideas such as "Composition from parts," "Forces," and the like, and use them without in the least knowing whether they have any truth, and in what it consists. As regards the content, however, they fail to express the truth of the object, but give only the sensuous phenomena. Aristotle and the ancients, on the contrary, understood under physics the comprehension of the idea of Nature—the Universal; and on this account it is called by Aristotle the Science of Principles. For in the natural phenomenon there enters essentially this distinction between the principle and its result (the result is the phenomenon), which vanishes only in what is really speculative. However, if on the one hand the physics of Aristotle is preëminently philosophical—not experimental, yet on the other hand the empirical is found in due measure. As has already been remarked when speaking in general of the Aristotelian philosophy, the different parts fall asunder into a series of ideas each defined by itself; such is here the case, and on this account we can speak only of each in its details. The relations of one to another are not unfolded; for each is treated as existing for itself. But in descending into details Aristotle proceeds beyond the sway of the [universal and necessary] idea, and his treatment becomes a superficial manipulation of grounds and reasons, and an explanation of proximate causes, such as we have in our science of physics.

As regards the general idea of Nature, it must be allowed that the same is exhibited by Aristotle in the highest and truest manner. In the idea of Nature according to Aristotle (Phys. II. 8) two determinations are found: the concept of *final cause*, and that of *necessity*. Aristotle seizes an object in its ground; this gives us the time-honored antinomy

or twofold point of view arising from the opposition of the category of NECESSITY (*causæ efficientes*) to that of CONFORMITY TO END (*causæ finales*). The first mode of consideration [according to efficient cause] is that according to *external necessity*, which is the same as contingency: in general, the objects of the natural world are apprehended as determined from without through natural causes. The second mode of consideration is the *teleological*; but conformity to end is either internal or external, and in modern thought the latter has for a long time been dominant. Thus the mode of consideration varies according to the stand-point assumed, and on one occasion it seeks external causes, while on another it uses the form of external teleology, which posits the end [purpose and design] outside of the natural. These determinations are well-known to Aristotle; he examines their essential nature to see how far they have validity. Aristotle's idea of nature is, however, more excellent than the one current in our time; for the chief thing with him is the category of the FINAL CAUSE as the internal determinateness of natural things. Thus he has apprehended nature as LIFE, i. e. as that which is final cause in itself and unity with itself; living being does not pass over into another, but determines, through this principle of activity, its changes in conformity to its peculiar content [or purpose], and hence preserves itself therein. Aristotle has in this view before him the internal, immanent conformity to design, and he considers Necessity to be only an external condition to this. On the one hand, therefore, Aristotle defines nature as the final cause, which is to be distinguished from fortune and accident: through this definition, it seems to be the opposite of necessity, which it contains also in it; *secondly*, he defines the manner in which Necessity appears in natural things. The term Nature one ordinarily thinks to include Necessity, and understands the Natural to include what is not determined through design. Nature has for a long time, according to the current belief, been defined philosophically and in truth as the province exclusively under the sway of Necessity. The view of Nature becomes defective, according to the common notion, when it allows the validity of the category of design or final

cause. The two moments of substance which we have considered, the *active form* and the *matter*, correspond to these two determinations.

We have first to consider the idea of conformity-to-end [adaptation to a purpose] as the ideal moment of Substance. Aristotle (Phys. II. 8) sets out from the proposition that the Natural is the Self-attaining; the difficult point consists in understanding this statement. "The first difficulty is this: what hinders Nature from acting according to a purpose, and that the best one? Jupiter rains not in order to make the corn grow, but from necessity. The rising vapor cools and falls as rain; it is therefore incidental that the corn flourishes. So also when the corn is destroyed by rain; the rain does not happen for this purpose, but the destruction is only an accident." That is, the connection is not a necessary one, but only an external one. This contingency pertains both to the cause and to the effect. Aristotle asks: "If that is the case [universally], what hinders us from assuming that what appears to be a part," for example, of an animal, "could really stand in an accidental relation also? That, for example, the front teeth are sharp and adapted to cut well, while the back teeth, on the contrary, are broad and fitted to crush the food—that this coincidence may be a mere accident without design. And so with the rest of the parts in which adaptation seems to exist; so that in this case the vital organism, in which all was so constituted in a contingent manner that it arrived at a conformity to purpose, now that it once exists, preserves itself, indifferent to its original origin from external necessity." This thought, adds Aristotle; was that of Empedocles, and according to it the first origin was depicted as a world peopled with monstrosities—e.g. the bodies of bulls with human faces—which shapes, however, could not endure, but perished, for the reason that no self-preservation could exist until the parts in conformity to a purpose had found each other; how, without these fabled monstrosities of the ancients, can we explain the multitude of animal races that have perished through inability to preserve themselves? In this way, moreover, the expression "progress" (a thoughtless form of development) is used in our modern philosophy of Nature. This is an idea at which a system of Natural Phi-

losophy easily arrives: that the first productions of nature are mere essays or attempts, none of which could abide that lacked conformity-to-purpose. [The reader will think of Darwin's "Natural Selection" here.] Nature, however, as Entelechy [self-end] is that which produces itself. Aristotle, therefore, replies [to the idea of Empedocles], "It is impossible to accept this idea. For that which happens in Nature, happens always or nearly always the same" (the external universality as constant return of what has disappeared); "but nothing which is through accident or chance reproduces itself. In the next place, that which contains a purpose (*τέλος*) conforms to this as well in its antecedents as in its consequences: so that the nature of the thing may be inferred from its constitution, and conversely its constitution from its nature; this follows from the idea of design." We call that the nature of a thing which becomes manifest through the becoming of a thing; it is the internal universality and adaptation to a purpose which realizes itself; so that cause and effect are really identical, since all the particular members are related to this unity of design. "Whoever assumes an accidental origin of things denies, in so doing, Nature and the natural order of things; for the Natural involves the possession of a principle in itself, by means of which a continual progress is made until the attainment of its end and aim." In this expression of Aristotle is contained the adequate, true and deep idea of *living organism*, which must be regarded as self-end: a self-identical which repels itself from itself, and in its externality still remains identical with its idea,—and hence is the self-attaining idea. Leaves, blossoms, roots, are produced by the plant and it by them; they produce the seed, and yet they presuppose the seed as their own origin. The chemical product seems, on the contrary, not to presuppose itself in such a manner, but rather to be a third produced from an acid and a base; yet even here the general essence of the two sides, their affinity, is extant beforehand, though as mere potentiality, while in the product it is mere *thing*. The self-preserving activity of life, however, produces this unity in *all* its relations. These statements agree substantially even with the assertions of those who do not take this view of nature. They say, for example, that is preserved

which is constituted as though it were conformable-to-design. For this is nothing but the self-producing act of nature. In the modern style of looking at life, this idea has been lost in a twofold way: first, through a mechanical philosophy which posits pressure, impact, chemical relations, forces, or some sort or other of external relations, as the basis; and though these are immanent to the nature, yet they do not flow from the nature of the body, but are a sort of appendage, as external as coloring matter in a fluid. Secondly, the theological system of Physics sets up the thought of a supramundane intelligence as cause of nature. The idea of Aristotle which has been stated above was first reestablished by the Kantian philosophy, at least so far as the organic realm is concerned, and the living organism is therein pronounced to be the self-end. Although this takes only a subjective form with Kant (his whole philosophy, indeed, has only a subjective form), and hence the living organism [vitality] would thus be defined [i. e. as self-end] only for our subjective reasoning, yet there is contained in this view the adequate truth that the organic form is the self-preserving. That the most recent times have returned to the rational view of this subject, is nothing else than a justification of the Aristotelian idea.

Aristotle characterizes this final cause which the organic manifests, and speaks of it in relation to the means which it uses (*Phys.* II. 8): "If the swallow builds her nest, the spider spreads his net, trees extend their roots in the earth for the sake of nourishment, then there exists in them such a self-preserving cause or a final cause." This instinct of action, namely, produces a work for its own preservation, as a means through which its essential nature is joined to itself and reflected into itself. Aristotle next brings what is here stated into relation to general ideas which he had already established previously: "Since nature is twofold, as matter and form, the latter [form] being the end and aim on account of which all changes occur, nature is final cause." The active form has, namely, a content which as content of the potentiality contains the means which manifests itself as conformable to the design, i. e. as moments posited through the particular idea. With how much soever repugnance one

may contend, in the modern way, against the idea of an immanent final cause, yet he must always acknowledge the existence in animals and plants of such an idea which preserves and restores itself in its other. For the reason that the animal, for example, lives in water or in air, he is so constituted that he may sustain his existence in air or water; thus, for example, the gills of the fish are adapted for water, the lungs of the mammal for air; and conversely, for the reason that he is so constituted — i. e. for air or water — his habitat is determined. This activity of transformation, therefore, does not belong to living beings as an accidental affair; it is excited by the external potencies, but only in so far as it is in conformity with the soul of the animal.

In this connection, Aristotle institutes a comparison between Nature and Art. Art also connects antecedents and consequences with a link of design. "A mistake can be made by Nature as well as by Art; in the same way that the grammarian at times writes false syntax, or the physician mixes a potion incorrectly, so Nature at times misses the achievement of what she proposes. Her failures are monstrosities and abortions,—which, however, are only failures when considered as the product of a designing cause. The marriage of animals or plants is productive first of mere seed, and corruption is still possible when in that state." The seed is, namely, the means, and it has not yet reached the state of Actuality, which is free, firm, independent, and indifferent. In this comparison of Nature with Art, it is customary to place before one the external conformity to design, the teleological view, the acting according to purposes: and against this view Aristotle speaks decidedly when he remarks further, that if Nature were mere activity according to a purpose, "then it would be absurd to refuse to think of action in conformity to design for the reason that one cannot see the moving object stop and consider." The understanding enters with the conception of this final cause, and with its tools works upon this idea of matter; we carry over this idea of external adaptation to a design, to Nature. "But," says Aristotle, "Art does not take counsel any more than Nature. If the form of a ship were the inner principle of the wood, then it would act from nature. The act of nature resembles

that practice of art most nearly, wherein one cares for his own preservation." Through internal instinct the animal fears danger and acts for his own safety; health is, therefore, essential in him, yet not as conscious purpose, but as an intelligence fulfilling its ends without conscious thought.

As Aristotle here contends against an external teleology, he likewise makes a correct remark (Phys. II. 9) against the mere external necessity; through this we come to the other question: how necessity exists in nature. He says: "They usually think of the origin of necessity somewhat as if one should suppose that a house is through necessity for the reason that the heavy is placed underneath and the light on top, so that the foundations and the rocks are placed lowest and then the earthy matter, and lastly the wood above all because the lightest." Aristotle, however, defines the relation thus: the house though it cannot be *without* this material, yet is not made *for* this material, but rather for the shelter and protection of many people. This is the case with everything that has a purpose in itself; it does not exist without relation to what belongs to its nature as necessary thereto; but it does not exist on account of the requirements of the material, but rather on account of a final cause. The Necessary is, therefore, only as presupposition and not as final cause; the final cause lies in the ground [*λόγος*, cause or reason], while the necessary lies in the material. It is therefore clear that necessity in natural things is limited to matter and its movements; each [matter and final cause] is to be posited as a principle, but final cause is the higher principle." The principle of necessity must be present, but by itself it does not suffice to give itself occasion to act, but is itself restrained by external necessity. The principle of matter is thus inverted in the true moving ground of the final cause, which is the inversion [opposite] of this principle of necessity, and therefore the natural preserves itself in the final cause. Necessity is the objective manifestation of the activity of its moments as sundered; as in the Chemical the essence of the two extremes, base and acid, is the necessity of their relation.

What we have given is the chief idea of the Aristotelian Physics. The remaining parts of the treatise relate to the ideas of different objects in nature, a task for Speculative

Philosophy involving the consideration of those subjects mentioned at the beginning of this chapter. Aristotle leaves on these subjects many deep and difficult speculations. He first proceeds to the subject of motion (*κίνησις*) and says: it is necessary that a Philosophy of Nature treat of this, but it is hard to comprehend; in fact, it is one of the most difficult of ideas. Aristotle then discusses motion in general, not merely motion in time and space, but also the real motion [i. e. self-motion]: he defines it as the “activity of a thing existing according to possibility so far forth as it is such.” This he explains as follows: “Metal is the possibility of a statue; but the movement requisite to become a statue is not a movement of the metal *as metal*, but rather a motion of the same *as possibility of becoming the statue*. On this account, this activity is an imperfect (*ἀτελής*) one, i. e. it is not “self-end”; “for the merely potential, whose activity is motion, is imperfect.” The absolute substance, the unmoved mover, which is the existing cause of the celestial movements, and which we lately considered as final cause, is, on the contrary, both the activity itself and the content and object of the activity. From this, however, Aristotle distinguishes that which falls under the form of antithesis: “The mover is also moved when it possesses motion as a [mere] potentialty and its not-motion is rest. That in which motion takes place possesses not-motion as rest; for the activity of that which is at rest is motion”: rest is, namely, potentiality to be moved. “For this reason movement is the activity of the movable (*κινητοῦ*),* in so far as it is movable; this, however, happens through contact with a mover (*κινητικοῦ*), so that the former [the movable] is passive. But the mover always introduces a sort of final cause (*εἶδος*), either a what (*τὸ ὅδε*), or a quality, or a quantity, which is the principle and cause of the motion when it moves anything; for example, the man existing according to activity produces a man from the potentially existing man. In this way, therefore, is movement

Note by Professor Michelet, the German editor.—“Aristotle distinguishes four determinations: (1) the moved potentially, or the movable (*κινητόν*); (2) the moved actually (*κινούμενον*); (2) the potential mover (*κινητικόν*), which Hegel calls further on “*das Bewegliche*”; (4) the actual mover (*κινούν*); it were, perhaps better to translate *κινητόν* by *Beweglich*, and *κινητικόν* by *Bewegerisch*.”

in the movable; for it is an activity thereof, and this activity proceeds from the potential mover; and the activity of the potential mover is no other [than that of the movable, i. e. there is one activity to both], the activity involves both [mover and movable]. The potential mover is the activity as potential, the actually moving mover is the same in activity: but it is the active impulse of the movable (*ἔστιν ἐνεργητικὸν τοῦ κινητοῦ*), so that there is only one activity to both; just as the relation of one to two and of two to one is the same—or just as the stairs are ascent and descent at the same time, and the way from Athens to Thebes is the same as the way from Thebes to Athens. Thus activity and passivity are not originally (*χωρίως*) the same, but are the same in movement. According to being (*τῷ εἶναι*) they are identical; but the activity in so far as it is an activity of this *in* this [i. e. in the moved], and the activity of this *by* this [by the actual mover], differ in idea (*τῷ λόγῳ*)". Aristotle next discusses the Infinite (Phys. III. 4–8).

Aristotle then speaks of place (Phys. IV. 1–5): "It is likewise necessary that the physicist investigate the idea of location (*τόπος*)"; here appear many different determinations; among them are *space* in general and definite space, or *place*. "Is space a body? No; for in that case two bodies [the body and its place] would be in one and the same place. Moreover, if it were the place and location (*χώρα*) of *this* particular body, it were evidently that of the surface and other limits; but the same reasoning could be brought up for the opposite, since where before the surface of the water was, now might be that of the air,"—thus the two surfaces have the same place. In truth, however, there is no difference between a point and its place; and so, too, place is not different from other forms of limit, nor is it something external to them. It is not an element, nor does it consist either of corporeal or of incorporeal elements; for it has magnitude, but nothing corporeal. The elements of bodies are corporeal, for no magnitude can originate from mere intelligible elements. Place is not the matter of things, for nothing consists of mere place; neither is place the form, or the idea, or the final cause, or the moving cause; and yet is something." Aristotle then defines location to be the first unmoved limit of what includes;

it includes bodies whose place it is, and to it pertains nothing of the thing it includes; yet it is coextensive with the object since the limits and the limited are together [coextensive]. The extreme ends of the including and the included are identical, and hence also both limits are the same; but they are not limits of the same, for the *form* is the limit of the object, and the place that of the including body. Place as the including remains in unchanging rest while the object is removed; it is, therefore, separable from it. In other words, Place is, according to Aristotle, the limit, the negative of a body, the positing of difference, of discreteness; but it likewise belongs to the including body as well as to the included: hence there is no difference there, but unchangeable continuity prevails [the limit is the connecting and identity as well as the separating and negating]. "Place is either the universal (*κοινός*), in which all bodies are" (the celestial space); "or the particular (*ἰδιος*), in which they are as in their origin." Aristotle speaks also of above and below in space, relating the same to the celestial regions as the containing, and the earth as the lowest: "In space there is a body outside of which is an including body. The entire heavens is not in a place, for no body includes it. There is nothing external to the universe, all is contained in the heavens; for the world is the whole. But place is not the heavens; it is only the outermost limits at rest which touch moving bodies. Therefore the earth is in water, the water in air, the air in ether, the ether in the heavens."

From this Aristotle (Phys. IV. 6-7) proceeds to consider empty space,—an old question upon which physicists of our day cannot agree: but it is all the same to them whether there is any thought in existence or not, or whether or not Aristotle ever studied the question. "The void is, according to the common notions of men, a space wherein there is no body. And since they take the corporeal for the existent, they call empty space that wherein nothing exists. The assumption of an empty space has its reason chiefly in the fact that a void [the negation of an existing mode of being] must be posited as the necessary condition of movement; "for a body cannot move in a *plenum*," there must be a void before it. "The other argument for the void is found in the elasticity of bodies,

which is possible through the existence of pores." This is that current notion that difference in density is to be explained through separation of the atoms, the difference in volume of two bodies of equal weight but of unequal size being due to the amount of void space between the atoms, the atoms being held to be all of equal size and weight. Aristotle refutes this explanation very neatly, and in a general form: "The plenum can be changed, and bodies can yield to each other even when no empty space separates them. Bodies, fluid as well as solid, are condensed not into the void, but through the expulsion of that which is contained in them, just in the same manner as air is expelled when water is compressed.

Aristotle speaks more profoundly on this subject when he combats the position that *the void is the cause of motion* (Phys. IV. 8). He shows that the void rather annuls motion, and that, accordingly, in the void there would be universal rest: the void is the perfect indifference into which a somewhat might move more or less; in the void all differences vanish. It is the pure negation, no object, no distinction: hence no ground or reason for standing still or for going further. But body is in motion, and it has thus distinctions; hence it has a positive relation and not to a mere nothing. On the other hand Aristotle refutes the other reason for the existence of a void, namely, that bodies yield. But one cannot establish a void in this way: there would not be one motion, but a motion in all directions—a general going to pieces, an absolute yielding, in which no coherence remained for the body. "Moreover, a weight or body is affected in its motion by two causes: the variation of the medium through which it moves, as air, water, or earth; or through its own constitution—having an excess, it may be, of weight or a deficiency of it." As regards the relation of motion to the density of the medium, Aristotle says: "The medium through which the body moves is a cause in so far as it retards—to the highest degree if it moves in the opposite direction (less if it is at rest) and is not easily divisible. To the variation of the specific gravity of the medium, air and water, the variation in velocity has the same relation; so that if the medium becomes twice as rare the velocity doubles. The void has no such relation to body, however, as if the latter were specifi-

cally heavier. Body exceeds the void in magnitude just as little as the line does the point, when the line is no combination of points. The void has no relation to the plenum." As regards the other case, the difference between heavy and light, which should be considered, in bodies themselves: the former move swifter than the latter in the same space; "but this characteristic holds good only in the plenum, for the heavy body divides the plenum more rapidly by its force." This view is quite correct, and is directed chiefly against numerous ideas that prevail even at the present day. The idea of like movement of heavy and light, as well as those of pure gravity, pure weight, pure matter, is an abstraction referring the difference to the accidental resistance of the air.

Aristotle comes (Phys. IV. 9) now to the *second* point, the assertion of the void against the distinction of specific gravity. "Many suppose the void to exist because of the existence of loose and firm bodies": the former is to be a porous body and the latter to be a perfectly continuous one; or they are distinguished from each other (still quantitatively) through greater or less density. "If, namely, a mass of water becomes air, then a certain amount of water must give a mass of air of like magnitude, or else there must be a void space; for only through this are condensation and rarification conceivable. If now, as they say, the less dense were that which is separated by many void spaces, since the void cannot be divided any more than space can have intervals, [in which there is no space,] nothing could be condensed. If, however, it is not divisible, and there still should be something void in the body, then, in the first place, there will be posited only upward movement; for the less dense is the light, and on this account they say also that fire is rare," i.e. because it always moves upward. "Then the void cannot be the cause of motion, because in it something is moved, just as in hose which carry up what is attached to them. But how were it possible that the void should move itself, or that there were a location for the void? For the place from which it moved would be the void of the void. At all events as there can take place no motion in the void, so also the void cannot be moved." Aristotle establishes the true nature of the object in opposition to these ideas, and everywhere sets up the ideal view of

nature: "That the contraries heat and cold and the other physical contraries have one and the same matter, and that from what exists potentially there arises what exists actually; and that matter is not divisible when it has the attributes of the idea,—and that it remains one and the same as regards number when it obtains color, heat, and cold. Likewise the matter of a small body is the same as that of a great one, since from a smaller a greater one is easily made and *vice versa*. If air is made from water, expansion occurs; the matter remains the same, however, without addition: but what it is potentially, it becomes actually. So likewise if a large volume of air is compressed there arises the opposite of the result before mentioned, and air becomes water, since the material of the two is potentially the same." Aristotle also asserts that the increase and diminution of heat and its transition to cold is no addition or withdrawal of caloric matter; also that dense and rare are one and the same. These ideas are very different from those entertained by physicists, who are prone to explain all variations of the kind by addition of matter, and to consider specific gravity as owing to the number of atoms a body contains. Aristotle, quite the contrary, takes this all dynamically—using the word in a sense very different from that current at the present day, namely as a synonym for intensity or degree;—he posits intensity in its correct sense of general potentiality. The difference must, of course, be still one of magnitude, but not as an increase or diminution, or as a change of the absolute mass of matter. But intensity means here *force*, and this again not in the sense of an abstract entity separated from matter; but in such a manner that if something becomes more intensive, its actuality has been diminished, but its potentiality increased. It is then indifferent whether greater intensity or greater extension is posited: a larger volume of air can be warmed to a given degree as well as a smaller volume, provided the heat is more intense; or the same volume of air can be heated to a more intense degree by that means.

"In the investigation of Time, Aristotle remarks (Phys. IV. 10–11, 13) that if one considers it externally (*ἐξωτερικῶς*) one must arrive at the conjecture (*διαπορῆσαι*) that time has no being, or it must be scarcely less (*μολίς καὶ ἀμυδρῶς*) than a

mere possibility. "For one side of time has been and is not, the other will be and is not; of these two sides, however, the infinite and ever-existent (*ἀεὶ λαμβανόμενος*) time consists. Now, however, it seems as though time were impossible if it consists of that which is not. For of each thing that is divisible, if it exists, some or all its parts must be. Time is now, indeed, divisible; some parts, however, are past, some will be, and there is no part present. The now is not simply a part: for a part has a measure, and the whole must consist of parts; time, however, does not consist of Nows." Because the Now is indivisible, it has no quantitative determination which could be measured. "Likewise, it is not easy to distinguish whether the Now abides the same, or is another and another forever. Moreover, time is no movement and change; for movement and change exist in a thing that is moved or changed. But time is the same everywhere. Change and movement is also slower or swifter, but time *not*. It is, however, not without change and movement" (which is nothing but the moment of pure negativity in the same): for where we perceive no change, there seems to be no time,—as in sleep. It is hence in movement, but is not it itself." Aristotle defines it thus: "We say then that time is, if we mark the before and after in motion; these are determined in such a manner that we take them for another and another, and between them again another as middle. If we now think the two extremes of the syllogism as another than the middle, and the soul speaks of the Now as two, the one the previous, the other the following; then we say, this is time. Whatever is determined by the Now we call therefore time; and that is the fundamental characteristic. But if we perceive the Now as one, and not as the before and after in motion, nor as the identity of something earlier and later, there then seems to us to have been no time because no motion. Time is therefore the number [measure] of movement in respect of the before and after; it is not movement itself, but it exists in so far as movement has number. The measure of more or less is through number, but that of the greater or less motion is time. But we call number as well that which is counted as that with which we count; time, however, is not number with which we count, but which is counted, and like motion is always another. The

Now is what the unity of number is, and measures time. The whole time is the same; for the Now which was is the same as the present (the universality as extinct "Now"), but in respect of being it is another. Time is, therefore, through the Now, as well continuous (*συνεχής*) as discrete (*διηρηται*). Through this it resembles the point: for it, too, is the continuity and discreteness of the line—its principle and its limit; but the Now is no abiding point. As continuity of time the Now unites the past and the future; but it likewise divides the time potentially,"—the Now is only divisibility and the moments are only ideal, "and in so far as it is a given one it is always another; it is, however, in so far as it connects, directly always one and the same. Likewise in so far as we divide the line, there arise for our thought other and again other points; in so far, however, as it is one, it is only one point. Hence the Now is in part the division of time potentially, partly the limit and unity of both," namely, of the fore and after. The universally dividing point is as actual only one; but this actual one is not a one at rest, but ever and again another, so that the individuality possesses universality as its negativity. "For the division and the union are the same, and according to one and the same; its idea (*τὸ εἶναι*) is, however, a different one. In one and the same respects are immediately absolute opposites posited as existing. In space, conversely, the moments are not posited as *existing*, but in it first appears this being and its movement and contradiction. The principle of identity set up by the understanding is therefore not at all the highest principle, according to Aristotle; but identity and non-identity is according to him one and the same. Since the Now is only now, the past and future are different from it: but they are likewise necessarily connected in the Now, which is not without fore and after; hence they are in one, and the Now as their limit is just as well their union as their distinction.

Aristotle (Phys. V. 1) proceeds to the consideration of the realized movement in things, to CHANGE (*μεταβολή*) or to the PHYSICAL PROCESSES—our consideration having been previously the pure movement. "In movement there is a mover and a moved, and a 'wherein' or time: besides this, a 'whence' and a 'whither.'" "For all movement is from something and

to something; but the first moved and the 'whither' and 'whence' it is moved are different: for example, *wood*, *heat*, and *cold*. The motion is in the wood, and not in the form; for the form moves not nor is moved,—neither do place or magnitude: but" (in the order as they follow) "they [form, place, and magnitude] are moved, and mover, and the goal of of the motion. That is called change which is rather the 'whither' than the 'whence.' Therefore also the ceasing in nought is called change, although that which ceases changes from being: and the origination of a thing is called change into the existent, though it be from non-existence." This remark is intended to signify that the relation of "whither" enters first in the real-becoming movement, i.e. in CHANGE proper; while the relation "whence" is that wherein change is still the mere ideal of motion. Besides this first form of distinction between movement and change, Aristotle adduces another, when he comes to classify change into three kinds, to wit: (1) change from a subject (ἐξ ὑποκειμένου) into a subject; (2) from a subject into a non-subject; (3) from a non-subject into a subject." The fourth, namely, "from a non-subject into a non-subject," which might be suggested by the mode of the general division, is no change; for it contains no contrast." It can indeed be thought as ideal, but Aristotle has reference to the actual phenomenon. "That from a non-subject to a subject is production (γένεσις); that from a subject to a non-subject is decay (φθορά); that from one subject to another is motion proper," because the subject in transition remains the same, and there is no becoming-other [alteration] of the actual, but a merely formal becoming-other [alteration]. This contrast of materialized movement as change to merely formal movement is worthy of note.

Aristotle comes in his sixth book to the consideration of the Zenonian dialectic relating to movement and change, namely, to the infinite divisibility. Aristotle solves it in this general way: it is shown to be nothing but the contradiction formed by the self-opposition of the Universal; the unity in which the moments are cancelled is not a nothing, (in which case the movement and change would not be,) but a negative universal, in which the negative is posited as affirmative again; this is the idea of divisibility.

Of the further details into which Aristotle goes I will quote only the following. Against the doctrine of atoms and their movement he remarks (Phys. VI. 10) that the indivisible has no movement and change; which is used to disprove that Zenonian proposition that there is only simple indivisible being and no movement. For as Zeno argues from the indivisibility of the atom against movement, so Aristotle argues from movement against the atom: "all that moves or changes is in the first part of time here, and in the last there." The atom as simple, indivisible being, however, cannot occupy two points of space, because it would be divisible in that case. The indivisible could thus be moved only on condition that time consisted of Nows; that this is impossible we have already proved." Thus, since the atoms have no change in them, and cannot have it from without through contact, &c., they are entirely without truth.

Next the pure ideality of change is an important point. Aristotle (Phys. VII. 3) says on this: "That which is changed is only the sensuously perceivable (*αἰσθητόν*); and the forms and shapes, as well as the properties are not changed: they originate and vanish in things, but do not change." In other words: the content of change is unchangeable; change as such belongs to the mere form. "Virtues or vices belong, for example, to accomplishments. Virtue is the perfection (*τελείωσις*) through which something has attained the aim of its nature; vice, on the other hand, is the failure and non-attainment of the same. They are not changes; but they begin and cease only when something changes." That is to say, the distinction becomes one of being and non-being, a merely sensuous distinction.

From these ideas Aristotle (Phys. VIII. 6, 8-9; De Cælo, I. 4) comes to the first real or physically existent motion: the first principle of motion is itself unmoved. An infinite straight-lined motion is an empty abstraction; for motion is necessarily a tendency to something. The absolute motion is a circular motion, because it is without antithesis. For since motion is to be considered in relation to its starting point and to its final cause, it is evident that the directions from A to B and from B to A in the straight line motion are opposed; but in circular motion they are the same. The idea that the celestial bodies would move for themselves in straight lines, if

they had not chanced to come into the sun's sphere of attraction, is an empty opinion far removed from the thoughts of Aristotle.

Aristotle shows next (*De Cœlo*, II. 1 ; I. 3) that the entire heavens neither originated nor is capable of ceasing, but is one and eternal: it has neither beginning nor end in eternal time, but contains infinite time in itself." All other ideas which are used to predicate of essence are sensuous; and in them there is always contained precisely what they meant to exclude. If they, namely, posit the void as existing before the commencement of all origination; in reality this very void is nothing else than the quiescent self-identity, i. e. the *eternal matter* which is thus already posited before the origin; for they would not say that before the origin there was nought. In fact, however, something first is in its origination, i. e. movement is necessary to the existence of something; and where reality is, is movement. But they do not bring together that void, the self-identical unoriginated matter, and this nothing. "That which has this absolute, circular motion, is neither heavy nor light; for the heavy is that which falls and the light that which rises." In modern physics, on the contrary, the celestial bodies are held to possess gravity, and would fall into the sun, but do not do it by reason of another force. "It is indestructible and uncreated, without increase or diminution, without any change. It is different from earth, fire, air, and water; it is what the ancients called ether, as existing in the highest regions, continually running its course (*ἀεὶ θεῖν*) in infinite time. This ether seems to be the eternal matter, but is not expressed definitely as such, and it remains fixed like our idea of the heavens. Here we begin to find the juxtaposition of different ideas hold more and more sway over their proper subordination.

Aristotle (*De Cœlo*, III. 6) shows further, that the elements do not arise from one body but from each other; for in their origin they spring either from an incorporeal source or from a body. In the first case they would arise from the void, for that is the immediate incorporeal; in that case the void would have to exist for itself as that in which definite corporeal existence takes its origin. But the elements, according to the supposition, do not spring from what is corporeal; otherwise

there would be a corporeal element existing before its elements. Hence the conclusion remains that the elements sprang one from another. Upon this it is to be remarked, that Aristotle understands by "origin" *actual* origin,—not the transition from the generic to the individual, but the origin of a determined corporeal, not from its ground, but from contraries as such. Aristotle does not consider the Universal as possessing the negative in itself; otherwise the Universal would be precisely the absolute matter whose universality as negativity is *posited*, or *real*.

Further on, Aristotle comes (De Cœlo, IV. 1–5) also to a kind of deduction of the elements, something very remarkable. He shows that there must be four of them in the following order, since he proceeds from the fundamental determination of heavy and light, which we call attraction and centrifugal force. The corporeal, says he, is according to its motion either light or heavy; and this is not merely relatively the case, but absolutely so. The relatively light and heavy is that which with equal volume will fall slower or quicker. The absolute lightness goes up to the extreme parts of the heavens, while absolute heaviness descends below to the centre. These extremes are fire and earth. Between these are intermediate elements which stand in similar relation to each other; and these are air and water, of which the one is heavy and the other light, though relatively so. Water, namely, pervades under all except earth, and air *over* all except fire. "On this account," infers Aristotle, "there exist these four matters; but four matters in such a way that they have one in common,—particularly since they arise one from another, their being is another than they." Yet Aristotle does not characterize the ether before mentioned as the common matter. Upon this it should be remarked here, that although these fundamental determinations are far from exhaustive, yet Aristotle has gone much further in the investigation of this subject than the moderns: he did not hold at all that idea of the elements which is current in modern times; according to that idea, the elements are simple and indestructible. Such a simple determinateness of what is existent is however an abstraction and has no reality, for, as defined, it would be incapable of motion and change; but an

element must also have reality itself, and is therefore, as unity of opposites, dissoluble. Aristotle lets the elements therefore, as we have already seen, arise one from the other, and pass over into each other: this is quite opposed to our physics, which understands by elements only what is simple and indestructible and self-identical. For this reason they are wonderfully wise when they upbraid us for holding water, air, &c., for elements! Moreover, modern physicists have never been able to comprehend the expression "neutrality" as a universality comprehended as unity, just as Aristotle ascribes it to the elements; in fact, however, an acid combined with a base is throughout nothing more (as they assert) than such [a neutrality] in this connection. But Aristotle is far from thinking "simplicity" in the sense of a mere abstraction, and he is just as little given to acknowledging the truth of that barren abstraction, the idea of composition from parts. On the contrary, he contends against it energetically, e.g. in his remarks in relation to Anaxagoras (*De Cœl.* III. 4).

I will now adduce the moments of the REAL PROCESS in relation to motion as Aristotle treats them (*De gen. et corr.* II. 2-4) before finally passing over to the "Principles of tangible body": here we see the elements in their processes, while before we saw them in their quiescent determinateness. Aristotle excludes those relations which exist only for sight, smell, &c.; and prefers to them those that exist for the sense that perceives the heavy and light. As these fundamental determinations he adduces heat and cold, dry and moist; they constitute the difference-for-others perceptible to sensation, while heavy and light are properties pertaining to the difference-for-themselves. In order to prepare the way for the transition from the elements to their sensible relations, Aristotle says: "For the reason that there are four principles,—and four things have in reality six relations to each other, but the opposites cannot here be united (dry with moist, and warm not with the cold),—therefore there are four combinations of these principles, (1) warm and dry, (2) warm and moist, (3) cold and moist, and (4) cold and dry,—and these combinations follow those primary elements; so that fire is warm and dry, air warm and moist (vapor), water cold and moist, earth cold and dry." Next, Aristotle endeavors to

make the reciprocal change of elements into each other conceivable in this manner: the beginning and ceasing go from one extreme into the opposite. All elements have an anti-thetic relation to each other; each is the non-being of the other, and one is distinguishable from another through the predicates of actuality and potentiality. Among these some have a part in common; e.g. fire and air have heat; if, therefore, in fire the dryness be overcome through moisture, then from *fire* arises *air*. But with those which have nothing in common with each other, as *earth*, which is cold and dry, or air, which is warm and moist, transformation goes on more slowly. The change of all elements into each other, the entire natural process, is to Aristotle therefore a circle of changes. This is unsatisfactory, for the reason that neither the individual elements are comprehended, nor do they round themselves to a whole.

In fact, Aristotle passes next over to meteorology precisely for this purpose, the consideration of the general process of nature [i. e. as a whole]. But we have here arrived at his limits. Here in the natural process this mode of simple defining as such ceases to hold good—this style of progressive determination fails to meet the wants of the subject, and loses its interest. For in the real process these defined and fixed ideas continually lose their signification, and become the very opposite of their definitions precisely where these indifferent links of the series condense and unite. In defining time and movement we saw Aristotle himself unite opposite determinations in this manner; but motion in its true character must take back into itself space and time; it must exhibit itself as the unity of these its real moments, and show how it contains them; i. e. show how this ideal comes to reality. Still more, however, is it necessary to show how the successive moments, moisture, heat, &c., are subsumed under processes. But the sensuous phenomenon begins here to gain the upper hand; for the empirical falls asunder like Nature into individualized forms. The empirical phenomenon so grows upon the observer, that he can impress upon it here and there only the sign of his taking possession thereof by thought, but it can never be thoroughly penetrated, as time, space, and motion have been, since it withdraws from the ideal further and further.